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MANAGEMENT IMPLICATIONS FOR RESOURCE RENTS IN THE SOUTH AFRICAN FISHING INDUSTRY

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1. PREAMBLE

Resource rents are those earnings that only exist because of a scarce natural resopurce, or one whose quality is variable. The value of South Africa's fishing industry is naturally based on the rents that it generates. These, in turn, are based on the quality, demographics and quantity of the fish that make up the resource. Informed fisheries management requires knowledge of current rents, and of their potential to change, as well as understanding of fish stocks. For this reason the United Nations System of National Accounts has moved to include fisheries amongst the resources for which "satellite" accounts are compiled. These are "comprehensive economic accounts" that integrate the value of natural resources into the existing national accounting framework.

The benefits of such accounts are numerous and include:

- *better estimates of the impact of regulatory programs on productivity,*
- *improved analysis of the costs and benefits of environmental regulation,*
- *and more effective management of the nation's public lands and resources.*
- *Augmented national accounts would also be valuable as indicators of whether economic activity is sustainable (Nordhaus and Kokkelenberg, 1999 in Repetto, 2002: 245)*

Statistics South Africa committed itself to generating such satellite accounts, but has hitherto been unable to collect the necessary data. This report addresses the problem and derives a single-year estimate of resource rents in the sector. It demonstrates that, with enhanced information gathering and reporting, satellite accounts for fisheries can become regular and comprehensive – substantially enhancing the management of South Africa fish resources.

A multi-year view of rent fluctuations across time, and between species, will provide a useful perspective on the health of fish stocks, and the potential economic benefits that could be realised. One important caveat is that resource rents, especially in the fishing sector, are volatile. Fishing costs rise and fall with fuel bills and fish stocks, which affect catch per unit effort. The movement of fish along the coastline also affects costs because processing plants are not similarly mobile.

On the revenue side exchange rates have powerful impacts, especially on the high value export components of the industry. Because of this volatility, State managers have to see beyond the condition of the fish stock. They need to acknowledge that risks are high in the fishing industry, and build this into their management approach.

2. INTRODUCTION

The fundamental imperative of the managers of South Africa's fisheries is necessarily the continued biological sustainability of the country's fisheries resources. This requires the assessment of these resources, an understanding of their interactions, monitoring of all harvesting and – ultimately – the introduction of measures to limit annual off-takes.

Hicks raised the notion of economic sustainability in his definition of income as, "the maximum amount an individual can consume during a period and remain as well off at the end of the period as at the beginning". This statement, interpreted for fisheries management when stocks are depleted below the MEY, equates income with net harvest revenues with the proviso that the fish population be non-declining.

The necessity that the resource be managed sustainably necessarily trumps other important objectives like the maximisation of resource rent, economic efficiency, social redistribution, job creation and poverty alleviation. These secondary objectives would be unattainable in the long run if the stocks were fished to non-recoverable levels.

Ensuring the sustainability of the resource is often taken to mean the restriction of fishing effort to a level consistent with the Maximum Sustainable Yield (MSY). This view is doubly flawed. Firstly a wide range of stock levels can be maintained sustainably. Secondly, if one wishes to maximise net benefits, the MSY is rarely equivalent to the Maximum Economic Yield (MEY). What is important is that South Africa's major commercial fish species have been harvested beyond both of these points.

Only once sustainability has been ensured[1] can fisheries managers decide which secondary, alternative objectives could be realised. In South Africa, the structure of the fisheries sector and its relationship with the State via the Department of

[1] It must be noted that constraining effort to MSY will not guarantee sustainability – interaction between species, and other environmental considerations can play an important part in a stock decline, or even collapse.

Environmental Affairs and Tourism's Marine and Coastal Management division (MCM) has an important role to play in this regard. At one extreme government can promote a lean, efficient, profitable fisheries sector, "which can be taxed to yield revenues that provide employment and meet development objectives elsewhere in the system." (BCLMEa, 2006: 2). It can alternatively coerce the industry into a higher cost, less efficient, but more labour-using system. "Despite these efficiency losses, this approach creates jobs directly and benefits those who have traditionally depended on the industry." (*loc cit*)

The former approach would, presumably, be consistent with the maximisation of resource rents by restricting effort to a position where the MEY is realised[2]. The State could then maximise sustainable tax income from the fishing sector and use it to create jobs anywhere in the economy.

The State can also intervene to reallocate wealth and income directly. Black Economic Empowerment initiatives and the reallocation of quota across the size distribution of firms - generally from larger to smaller firms and from older to newer firms - are cases in point. The existence of significant scale economies in harvesting, as well as processing and marketing, means that such restructuring efforts can impact directly on total rents.

3. BRIEF INTRODUCTION TO SOUTH AFRICA'S FISHERIES[3]

The South African fishery is made up of around 20 species (BCLMEb 2006: 3) but this report is concerned with the seven major commercial species: Hake, Pilchard, Anchovy, West – and South Coast – Rock Lobster, Squid and Horse Mackerel.

Fishing in South African waters is a high-risk activity. Catches, costs and product prices are all volatile, and future permit rights are uncertain. The industry therefore suffers from concurrent physical, market and political risks.

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[2] This, incidentally, is the equivalent to the effort level a monopoly producer would operate at – this is discussed further in Section 5.

[3] This section was largely informed by a research project the author completed, and updated, for the BCLME project in 2006: BCLMEa

Accordingly, catches in South African waters show considerable annual variation. This can be seen by looking at total catch statistics: thus just over 800 000 tons of fish were caught in South Africa in 2003, while in 1997 the catch was 45% lower at 445 000 tons.

In recent years there has also been considerable geographic variation: while the West Coast catch historically dominated South Africa's fishery, representing around 90% of the catch by volume, in recent years an increasing proportion of the catch has been captured off the South Coast.[4] These changes in volume are especially true of the small pelagic fisheries - f short-lived species with high inter-annual variations in recruitment often associated with environmental perturbations.

In South African waters the main stocks are certainly depleted, but by world standards are in reasonable condition, and the OMP system appears to be working well. Subject to the limitations on management before the introduction of 200 nautical mile EEZ South African commercial fish stocks have been historically well managed, primarily through catch and effort controls, and by utilising a strong research base.

The research and management of the marine resources was traditionally a responsibility of the Sea Fisheries Research Institute (SFRI) with funding from the industry channelled through a stabilisation fund. The latter was necessary to correct for the effects of fluctuations in fishing rents. SFRI was subsequently incorporated into the division of Marine and Coastal Management, one of four divisions that make up the Dept. of Environment Affairs and Tourism.

Since 1998 the fund has been known as the Marine Living Resources Fund. Unfortunately the industry rents captured for this fund are no longer solely targeted at the research and management of the fish stock; pollution control and a range of socio-economic objectives also being funded by it.

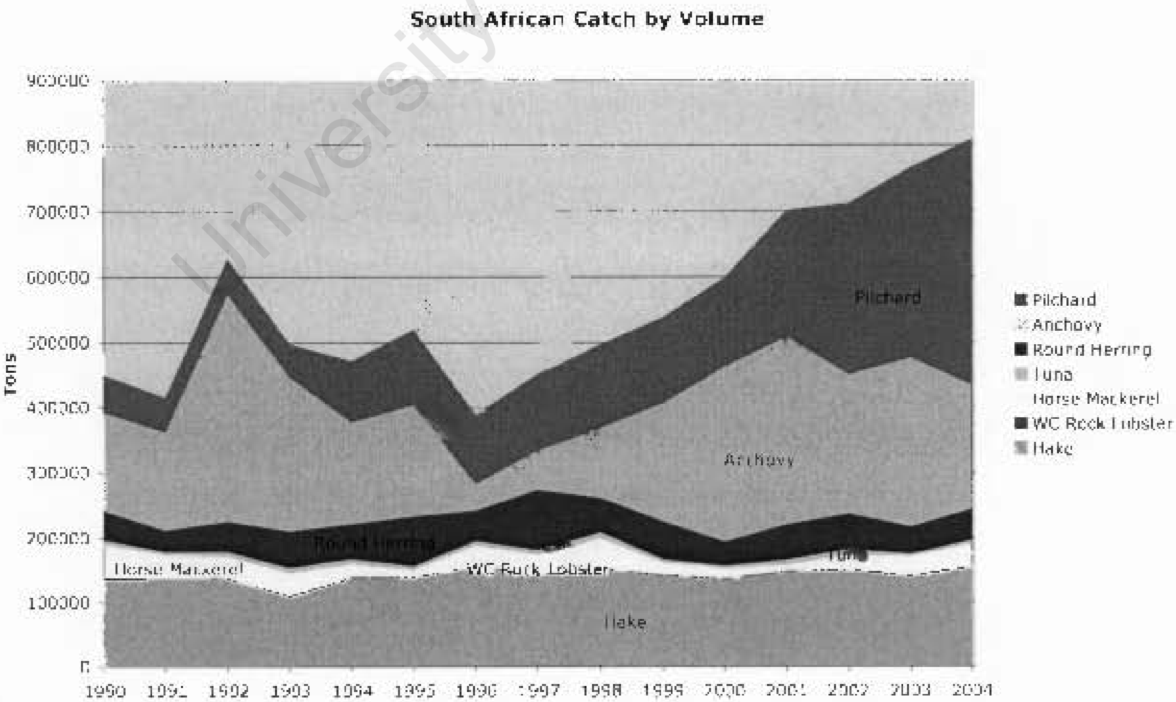
[4] Since the processing plants are largely located on the West Coast, this has raised costs in the industry.

Responses to MCM's Long Term Rights Application process of 2004 indicate that there are 1,432 entities operating in the various fisheries relevant to this study[5]. They also indicate that there are 81,736 employees in the industry, although this figure includes part-time employees and some double-counting where workers are employed in more than one fishery. It is also likely that some respondents may have inflated their employment estimates to paint their applications more favourably.

The more-reliable Economic Sectoral Study estimates that direct employment in the fisheries sector is 27,730 – assuming roughly four dependants per worker, this means that some 120,000 people are supported by the fisheries (Mather *et al*, 2004). It also reports that there were 4,669 licensed fishing vessels in the *entire* South African fleet in 2000, 1 969 of which were small, inshore line fish vessels.

The Benguela Current Large Marine Ecosystem Project (BCLME) estimated that there were only 566 vessels licensed, commercial vessels operated by quota holders in the Hake, Small Pelagics, Horse Mackerel and Rock Lobster fisheries (BCLMEb 2006: 128).

Figure 1



Source: FIGIS, 2006

[5] Table 2 in Section 7 details the relevant sectors

In 2004 fish products ranked 20th on the list of South Africa's exports by value – and South Africa had a 0,7% share of world fish product exports (TradeMap, 2006). While global exports in fish products grew by 6% between 2000 and 2004, the growth in South Africa's fish exports in the same period was more than double, at 13% (*loc cit*).

In the late nineties, 100 000 tons of fish exports, worth roughly R1 billion, made up 11,1% of South Africa's primary sector exports but only 1% of total exports. By 2004 the value of exports had more than doubled while the volume of exports increased by 20% – the percentage contribution to South Africa's exports remained roughly the same. The main destination for exports, at 25% by volume, is the Spanish market – the rest of the European Union receives over 15% of the exported product from South Africa. Roughly a quarter of all exports are bound for inter-regional markets, mainly the DRC, Zimbabwe, Zambia, Mozambique and Mauritius *(loc cit).*

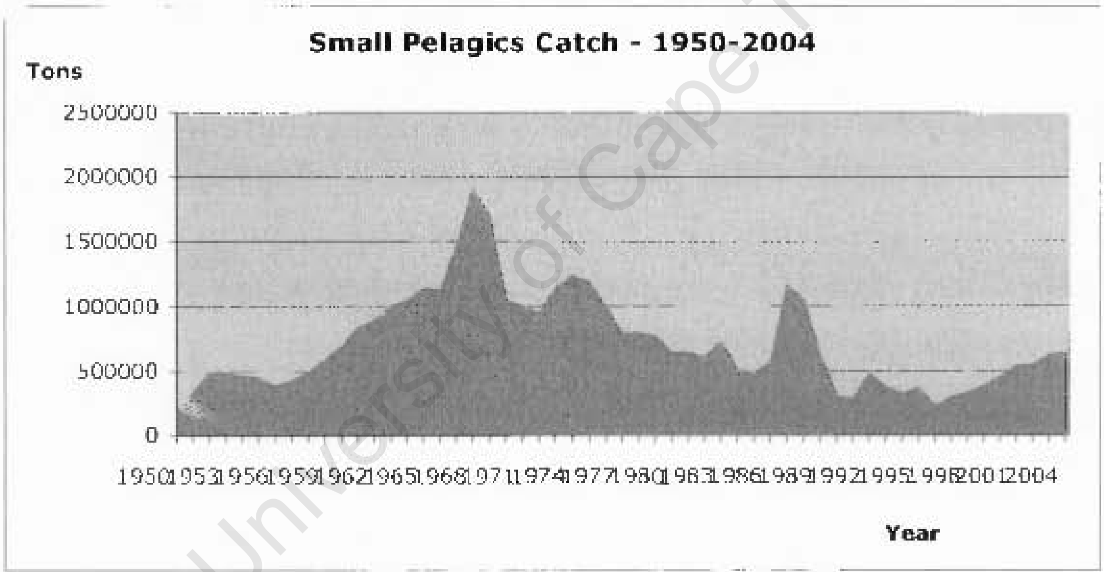
By volume, South Africa imported more fish products than it exported over the period 2000 to 2004 - on average 200,000 tons of fish, valued at R0,7 billion, were imported per year. The average value of an exported product (across all products) at R10/kg was significantly higher than the average value of an imported product at R3,50/kg. This reflects a relatively competitive production advantage that indicates the sophistication of the South African fisheries production complex. This sophistication stems from the strength of the vertically integrated fishing companies which, for profit-margin maximisation reasons, focus on value-adding activities by importing non-processed bulk products and processing them into higher value specialised products. Because the distribution is in place, and local consumers are relatively unsophisticated in their demands, processing companies are able to satisfy the local market with cheap imported - or inferior local - fish products while exporting local whitefish, and a limited number of other products, at a premium.

One example of trade imbalance that could impact regional development is the fact that, in 1999, supplies from neighbouring countries accounted for only 8% of import demand in South Africa – even when most of these countries demonstrated a considerably larger supply capacity. At the time South African trade and industry officials, in response to this finding, assured that "under the SADC Trade protocol, South Africa has committed to reduce, in a phased-manner, import tariffs on a wide range of products resulting in a duty-free entry of approximately 90% of sub regional exports to South Africa" (International Trade Centre, 1999).

By 2004, however, this percentage had actually decline to 7,5%(TradeMap, 2006) - indicating both the ineffectiveness of the SADC Trade protocol and the decline of fish stocks in Namibia.

3.1 Small Pelagics

Figure 2



Source: FIGIS, 2006

The Small Pelagic fishery in South Africa is traditionally the largest by volume landed, however, both the total catch volume and its species composition may vary significantly from year to year. Once purse seiners began to seriously target anchovies these fish typically accounted for 50-60% of the total small pelagic catch; this percentage declined to approximately 20% during the mid- 1990s and then returned to its previous proportions (Intracen, 1999a). The SADC Fisheries unit has defined the increase in the anchovy catch in 2000 as a 'boom' (2004). Subsequently catches of pilchard rose in 2004 and then fell-off.

Pilchard catches, on the other hand, remained relatively stable during the late 1990s after increasing significantly during the 1980s and early 1990s. In 1987, the pilchard catch accounted for 6% of the total pelagic catch – by 1997 this proportion had risen to 41% where it remained stable up until 2000. Thereafter catches rose sharply, processing capacity rather than stock abundance setting the limit on harvesting. Post 2004 stocks both declined and shifted (to the South and East).

The recovery of the South African pilchard stock in the period prior to the permit reallocation process appeared to allow broader access to the resource. The management of this reallocation process was a primary activity of MCM in the subsequent period and one of the major expenditures in its budget. Although a number of empowerment companies have entered the processing side of the industry, many new rights holders concentrate only on catching, and sell their catch to existing processors.

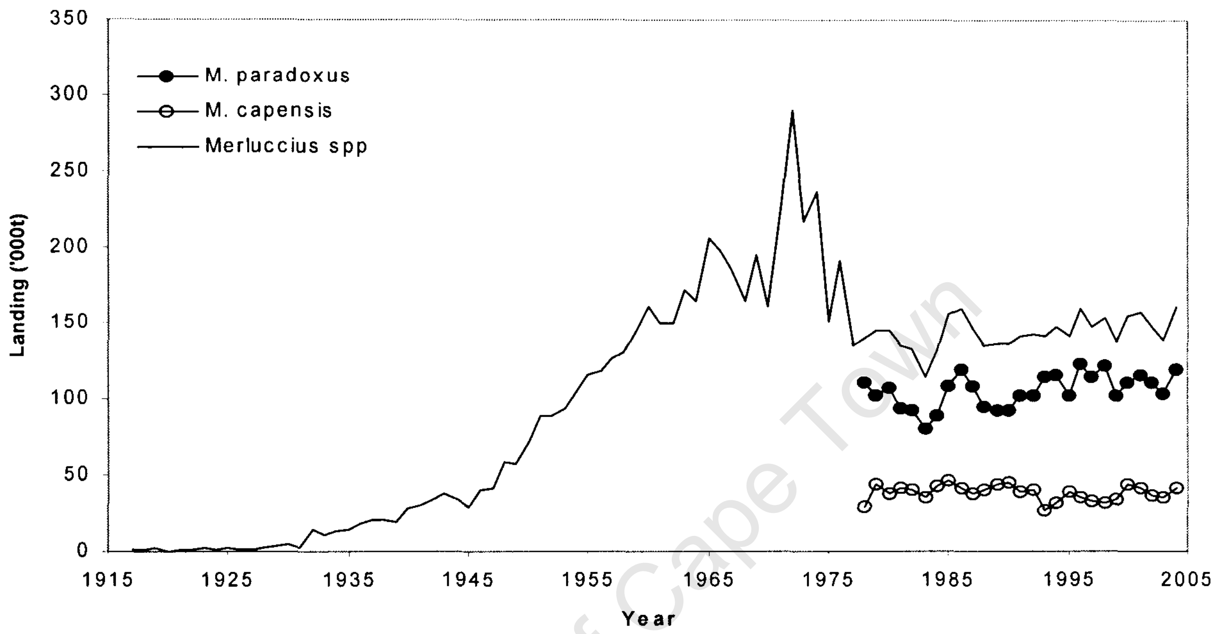
The industry is vulnerable to the effects of fluctuations in total allowable catch (TAC), particularly because a number of operators are marginal concerns, and increased attention is being paid to eliminating paper quota holders. The small pelagic OMP recognises this variability and aims to minimise the impact of inter-annual TAC fluctuations. The current management procedure in South Africa is based on a joint pilchard and anchovy quota, the allocation being topped up mid-way through the season should the resource justify it.

Any switch from anchovy back to sardine raises the value of the small pelagic catch. Sardine offers the potential for extracting higher value-added oil, and focusing on quality rather than volumes since it can be either canned or processed into fishmeal[6]. This pilchard premium underlay recent legal challenges to the small pelagic management system.

[6] Recent debate on the issue raises the suggestion that pilchard may be better utilised through value-added by canning, rather then processing it into fishmeal (pers com: Japp 2006).

3.2 Hake

Figure 3: *Annual landings of Cape hakes (solid line) by all sectors in the hake fishery since 1917.*[7]



Source: MCM, 2005

In South Africa, hake trawlers and small pelagic purse-seiners account for more than 90% by weight of the total commercial fish caught, though hake is a significantly more valuable fish.

Survey estimates show that hake populations (M. Paradoxus and M. Capensis) in South Africa were on a slight upward trend for the 20 years ending 2004 (see Figure 3), but recent models suggest a decline in stocks. Catch rates have certainly fallen and the proportion of small fish (which bring in a lower price per tonne) in the population has risen. The result has been a sharp drop in the rents provided by these two species.

[7] From 1978 the annual landing is apportioned between M. capensis and M. paradoxus based on a relationship between species ratio and fishing depth

Hake in South Africa is caught by bottom trawl, and to a lesser extent by long lining with a small hand-line catch. Long-lined hake is mostly landed wet (on ice) and sold whole or headed and gutted. Trawled hake can be landed wet (iced) or processed and frozen offshore. Products include headed and gutted, whole, filleted, skinless fillets and processed into value-added fish products, or white fishmeal. The optimal processing path depends on the size and quality of the fish, and on the technology used to catch it.

When the medium term allocations were issued in 2003 there were 52 trawl right holders sharing a TAC of 126,687 tons and approximately 140 long-line rights holders entitled to 10,318 tons. The largest trawl allocation was 44,819 and the smallest 364 tons. All but three of the long-lining allocations were less than 100 tons with the largest of 719 tons allocated to a consortium but still with individual boat quotas that were under 100 tons.

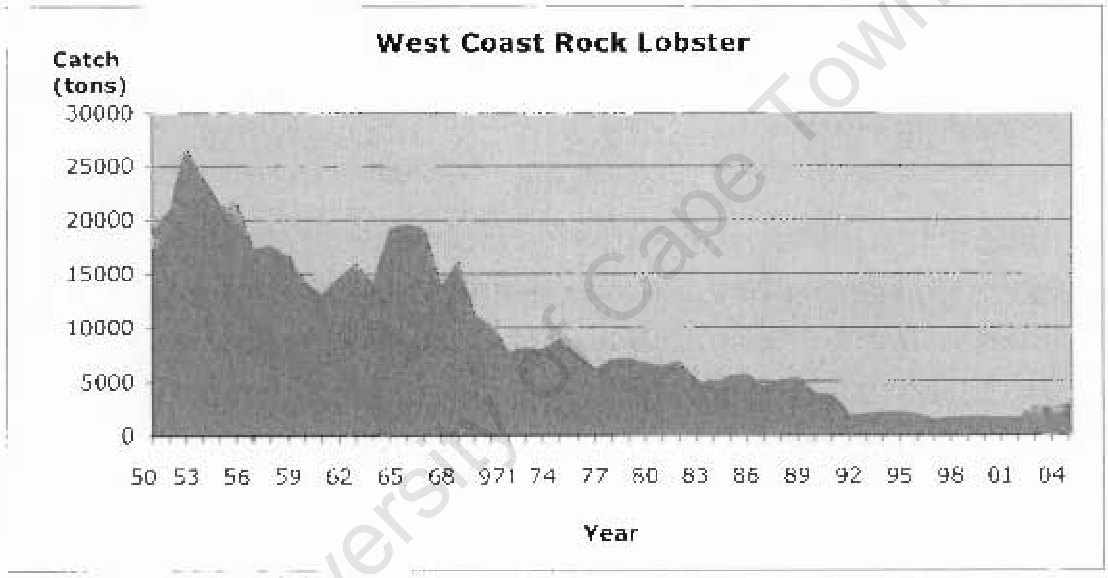
There was a levy of R165/ton in 2003 on both trawled and long-lined hake. In addition a license fee per vessel is charged. This fee was a sliding scale, but all boats greater than 20m paid R1 260 in 2002.

Access to the hake resource has broadened over time with two primary rights holders dominating the allocation before 1990. The situation changed in the early 90's to include up to ten rights holders, but the industry was still dominated by the two major companies. In the Medium term rights allocations for the period 2002 to 2005 the number of rights holders in the trawl sector increased to 54 and was decreased to 52 with the allocation of long-term rights in 2006 (pers. Com. Japp, 2006).

The broadening of access in the rights allocation processes occurred at the cost of the large enterprises that formed the historic core of the hake industry and remain the primary fish processors. These firms are also those best able to cope with the changing size distribution of the catch and to maintain their economic viability in the face of catch fluctuations. The redistribution policy has consequently had an opportunity cost on industry rents.

The TAC for hake was introduced in 1978. In 1983 the quota was 120 000 tons and then increased upwards to 165 000 tons in 2002. In 2004 the South African hake industry was awarded the Marine Stewardship Council (MSC) standard for sustainable fisheries – reflecting the perceived healthy state of the stock. Unfortunately the subsequent declines in catch rate and average size led to a cut in 2005's TAC from 161 000 to 158 000 tons. In 2006 the TAC was further reduced to 150,000 tons with a further 15000 tons reduction in 2007 to 135 000 tons.

3.3 West Coast Rock Lobster



The total West Coast rock lobster catch declined steadily from 5 924 tons in 1987 to a TAC of 1500 tons in 1995/6. While some have attributed this decline to an unknown environmental anomaly that appeared to affect the somatic growth rate, it is also possible that the original lobster growth rate, used to inform stock management, was wrongly estimated. Conservative management has allowed some revival of the stock and the TAC was up to 3527 tons in 2005.

The commercial lobster industry in Southern Africa has been geared towards exports since its inception. Freezing has replaced canning since the Second World War, and today rock lobster is exported in a range of forms. According to market preference these include; whole cooked frozen, whole raw frozen, frozen tail, and live.

Presently approximately 80% of the TAC is allocated to offshore harvesting, and the balances reserved for small-scale inshore fishers - noting that the west coast rock lobster TAC also accommodates an estimate for recreational fishers. The maximum individual quota here is 2 tons per annum. The number of these rights is, however, the subject of intense current debate and the appeals process has so far more than doubled the number of permits from that initially allocated under the medium term rights process. This is a high value product and an industry where annual harvests have fallen significantly over the years.

3.4 Horse Mackerel

A mid-water trawl fishery targets horse mackerel, a semi-pelagic species that dominates the Namibian industry, but is less significant in South Africa. In South Africa the fishery for adult horse mackerel is found only off the Agulhas Bank where it is harvested by one large midwater vessel using midwater gear. Adults are also a by-catch of hake trawlers.

Currently (2007) there are 18 rights holders in the Horse Mackerel fishery. Until recently a large Russian trawler catching for a number of quota holders dominated the fishery, but a large trawler owned by one of South Africa's largest fishing companies has superseded this vessel. The size of the mid-water trawl fleet is variable, with some of the hake trawl catching capacity being used to catch horse mackerel when circumstances permit.

3.5 Squid

The Eastern Cape is host to an important fishery targeting squid *(Loligo vulgaris reynaudii)*. The fishery targets spawning aggregations using jigs. Almost the entire catch is exported; the South African product commanding a premium on world markets. After its initiation in 1983 the fishery grew rapidly until a permit system for vessels was introduced in 1987 to limit fishing effort. In 2003 128 medium term rights were issued comprising 2 400 fishers on 138 boats. As the fishery is input-controlled, catches fluctuate from year to year, sometimes as high as 12000 tons and in other years as low as 4000 tons. The resource is protected by a closed season of 3 to 5 weeks when spawning is at its peak (usually November).

3.6 Other Fisheries[8]

Abalone

South Africa's commercial abalone fishery remained relatively stable for many years, being controlled by a whole mass quota of some 600 tons. The fishery is divided into seven fishing zones, but most of the commercial catch is harvested from only five. A TAC is set for each zone. Other means of protecting the resource are a closed season and a minimum legal size limit of 114 mm. Licensed commercial divers operate from small boats and use the "hookah" system of air supply, in which a portable compressor channels air through reinforced hosepipe. Most of the catch is canned or frozen and exported to the Far East, although legislation stipulates that 10 percent must be sold in South Africa.

The lucrative market in the Far East has in recent years stimulated an escalation in illegal fishing activity. At the same time the number of recreational divers increased. Because of the poaching and the sharp decline in the biomass, the recreational fishery was stopped in 2003 and the commercial fishery has been sharply decreased with a TAC of 237 tons in 2004. Rights in this sector were renewed in the 2003/2004 season for 10 years.

Line Fishing

The South African line fishery is split into three main components: the hake handline fishery, the tuna fishery and the general recreational and commercial line fishery.

The commercial fishery for tuna began in 1960. Although poling, is the primary means of exploitation targeting albacore tuna and to a lesser extent yellowfin tuna, longlines are also significant. South African tuna catches approximate 4 000 to 6 000 tons per year. The fishery is seasonal, from September through to March. It is now believed that total Atlantic Ocean albacore catches exceed the maximum sustainable

[8] Informed by Japp pers com, 2007

yield of 25,000 tons and are not sustainable. South Africa is a full member of the International Commission for Atlantic Tunas (ICCAT) and is presently lobbying for the allocation of country allocations.

Catches in the commercial line fisheries peaked at 18 000 to 20 000 tons in the late 1960s and early 1970s, but then declined steadily to an estimated 7 300 tons in 1985. This was despite an increase in fishing effort as smaller, faster and more transportable ski boats replaced the earlier line boats. The newer vessels enabled fishers to concentrate effort where fish were available and to follow migratory species along the coast, so effectively increasing pressure on the declining resource. The dropping catches, together with a decrease in the mean sizes of fish caught, led to calls for the protection of linefish stocks, and in 1984 the South African Marine Linefish Management Association was formed.

Today management measures include minimum size limits, bag limits, closed seasons and closed areas (marine reserves), but catch rates continue to decrease as the numbers of fishers (commercial and recreational) rise annually. A crisis has been declared in the fishery, allowing the Minister to take appropriate action to protect stocks. Certain species have been protected and numbers of fishers in the sector were drastically reduced with the medium-term allocations in 2003 (137 rights issued). Presently there is a Total Allowable Effort (TAE) of 450 boats with 3 450 fishers. Tuna, shark and swordfish longline is a developing sector in South Africa. Historically Foreign effort (mostly Japan and Taiwan Province of China) has dominated with about 130 permits issued annually. The issuing of foreign flag permits to longline for tuna has been terminated.

After an experimental fishing period, long-term fishing rights for directed effort on tuna (30 rights) and swordfish (20) were issued in November 2004 to South African rights holders. Many of these rights are presently fished by foreign flag operators in joint venture with the South African rights holders with the main objective of increasing South Africa's catch history for tunas.

The small shark-directed longline fishery has been integrated into the large pelagic longline sector and from 2006 pelagic shark longline rights will cease. However, a small demersal (bottom) longline shark fishery will be permitted.

Other

Other marine fisheries include several small coastal net fisheries, wild oyster exploitation and a small trawl fishery on the Natal coast for prawns. These fisheries are also included in the long-term rights allocation process. The policies developed for sectors such as for oysters and beach seine focus on small-scale and coastal community fishers.

Subsistence and artisanal fisheries are located mostly in rural areas, including the former Transkei and KwaZulu-Natal coastlines where activities such as oyster and mussel picking occur. In some areas there are also permits for subsistence fishers for the harvesting of rock lobster and abalone.

4. NATIONAL ACCOUNTS & NATURAL RESOURCES

The United Nations has led a global effort to embed the concept of sustainable development into the System of National Accounts (SNA). This proposed reform of the national accounting system is directed by the *Integrated Environmental and Economic Accounting Handbook* 2003 (SEEA). This paper follows the guidelines laid out in the UN's *Integrated Environmental and Economic Accounting for Fisheries Handbook (SEEAF);* that sets out to provide

> *a common framework for organizing economic and environmental information related to fisheries, permitting the monitoring of the economic importance of fisheries, the improvement of fisheries management and the estimation of the full costs and benefits of fisheries.* (United Nations, 2004: 5)

The establishment of a satellite account for fisheries will allow the national accounts to quantify the value of the natural resource itself, rather than merely quantifying the value of its depletion. Traditional national accounts record the mining and harvesting of natural resources as income, and take no account of the degradation of the resource, or even the value of the remaining natural capital. A satellite account for fisheries would treat natural resource depletion as capital depreciation rather than as income, and the accumulation of natural resources as investment rather than forgone earnings.

The formation of a fisheries satellite account in South Africa will bring a broad range of benefits to fisheries managers and, ultimately, the managers of the country's economy. The SEEAF defines three broad sets of issues that can be addressed with information from the fisheries account, namely: monitoring the economic importance of fisheries, improving fisheries management, and estimating the full costs and benefits of fisheries (United Nations, 2004). These are expanded upon in Table 1, below:

Table 1

Issues that can be addressed with Fisheries Accounts	
Monitoring the economic importance of fisheries	Contribution to national income, employment and foreign exchange earnings of fisheries and its sub sectors
	Distribution of benefits from fisheries among different groups in society, e.g., commercial, recreational, and subsistence fisher
	Economic linkages between the fisheries sector and other sectors of the economy
	Value of natural assets, in particular commercial fish stocks, and the cost of depletion
	Value of fisheries resources shared with other countries
	Monitoring implementation of international instruments (e.g., UN Law of the Sea, UN Fish Stocks Agreement, Code of Conduct for Responsible Fisheries)
Improving fisheries management	Assess the economic efficiency of fishing in the sub sectors, and the potential value of fish under alternative management and policies. Fisheries management can then be compared to management of other resources in the economy
	Assess government policies, such as fisheries taxes and subsidies, on incentives for sustainable utilization of fishery resources, on the distribution of access to fisheries and benefits from fisheries. Again, fisheries policies and management can be compared to other resources in the economy
	Assess the impact of macro-economic policies on the fisheries sector, such as economy-wide changes in taxes or interest rates. Are fisheries especially vulnerable to specific policies?
	Monitoring the inter-relationship between fisheries, the natural resource base and ecosystem health
	Management of resources shared with other countries, including on the high seas.
Estimating the full costs and benefits of fisheries	Assess the extent of resource rent recovered by the government, accrued to the private sector, or dissipated on overcapacity and over fishing
	Assess the extent of government fisheries management costs and habitat protection costs
	Assess environmental externalities caused by fisheries, or generated elsewhere in the economy and borne by fisheries (measured in both physical and monetary terms)

Source: UNITED NATIONS, 2004 (17)

In addition to these benefits, a properly constructed and functioning set of fisheries accounts would indicate the potential benefits of policies that offer short-term alternative opportunities to fishermen in depleted fisheries.

This report has rather more modest ambitions than those laid out above, but the importance of a 'first-run' investigation of the feasibility of fisheries accounts in South Africa - as well as an initial, single-year estimate of the national resource rent from the major fisheries, and interpretation of their management implications - should not be underestimated.

The SEEAF provides a set of standard approaches to developing fisheries accounts, and this study attempts to use one such methodology to calculate the physical account, as well as the monetary account, for the major South African fisheries (United Nations, 2004).

The estimation of such accounts is a relatively difficult endeavour, even in countries with well-established records of fishery statistics. The reason is that fish, unlike forests, for example, are not directly observable. This means that stocks need to be estimated using sample testing, biological knowledge and mathematical extrapolation. Many fish species interact in ways which affect stocks, and these interaction can be very difficult, and costly, to model.

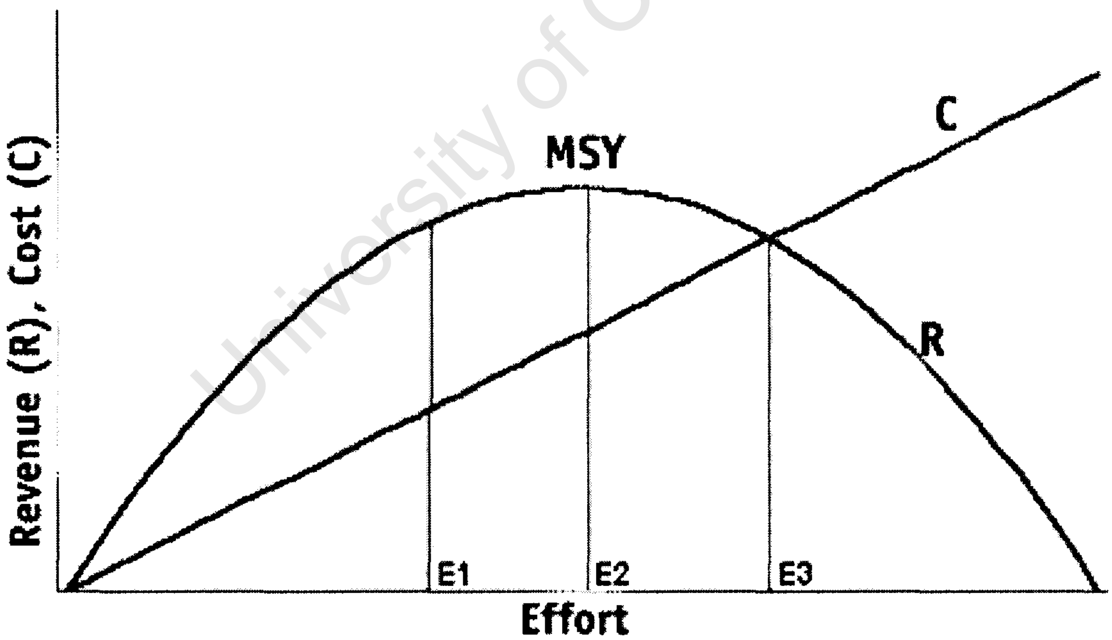
South Africa has the added challenge of an uneven record of fisheries data. There is no regular survey of fishing companies, and Marine and Coastal Management only recently recommenced publishing official catch data, after a hiatus of several years. Until recently many researchers have relied on data from George Warman - a private sector publisher, which puts out some semi-official figures in their annual *Fishing Industry Handbook* - for economic and sectoral information. MCM has, in the past, produced an economic review of the South African fisheries; these reviews have not been produced in recent years and the historical reports are outdated.

5. RESOURCE RENT: data and calculation

The resource rent of a fishing company is the return it receives over and above its opportunity costs. In other words, it is the revenue in excess of that needed to cover the costs of catching and a return on capital just sufficient to keep the firm in the industry over the long run. This rent is attributable to the scarcity of the fish, either due to limits in the stock, or to restrictions on fishing. A naïve Schaefer model can be used for heuristic purposes to show how such rents accrue and how they can be dissipated.

Figure 3 is the financial representation of a Schaefer curve that plots the yield of a fish resource against the effort put into harvesting that resource. It shows that, as effort increases, so does the yield of the resource – up until effort level E2, where the Maximum Sustainable Yield (MSY) is reached.

Figure 3



Source: DIFID, 2006

Beyond this point, as effort increases, so the yield of the fishery decreases. Resource rent is represented by the vertical distance between the revenue curve (R) and the cost curve (C). If viewed in a single time period the maximum rent is realised at effort level E1 – the Maximum Economic Yield (MEY) which represents a lower effort level than that which reaps the MSY.

If the distorting effects of interest rates are omitted, then were fishery harvested by a monopoly with long term sole rights over the resource, that firm would rationally operate at effort level E1. Here it would maximise its profitablity. However, in a fishery where competition is permitted and entry is possible, more firms will enter the market, adding to the total effort levels until point E3 is reached, where they will be making a normal profit only, i.e. just covering their accounting and imputed costs. At this point the economic rents have been dissipated by excessive effort. This has raised industry costs and lowered yields. The economic rent is zero and the fishery is both biologically and economically overexploited with a harvesting effort level of E3.

This outcome: that a monopoly producer represents both the optimal economic and biological solutions for a supply-side market, runs contrary to most classical economic conclusions. The implication of this is that a fisheries manager should, ideally, maximise the economic rent realised by a fishery by constraining effort to point E1 – effectively replicating a monopoly situation, but doing so through an efficient allocation process. In a perfect world this would be accomplished setting an effort limit of E1 (or a TAC equivalent to it) within the context of a competitive marketplace. Sadly this has proved almost impossible to replicate anywhere in the world.

In effect, for a "new" fishery with no history of prior fishing, a monopoly fishery with guaranteed long term rights is likely to be the most economically, and socially efficient industrial structure, requiring no regulation or management by the State whatsoever. Of course, social and historical realities mean that this is hardly ever the case, especially in a country with as long a fishing history as South Africa.

6. METHODOLOGIES

The SEEA includes mari- and aquaculture, as well as fresh water, and recreational fisheries in its guidelines for fisheries accounts. Due, in part, to the lack of data available on the South African fisheries mentioned above[9], this study focuses only on the major fish species and their associated fisheries. The resources covered do, however, constitute the vast majority of the South African fisheries, by volume and value.

5.1 Physical Accounts

The physical accounts show the status of the fish stocks in the period under question by listing the opening stock, the changes in the stock and the closing stock. The major change from economic activity is the annual catch. According to the guidelines in the SEEAF "other changes in the volume of assets include catastrophic losses but also the net natural growth of the stock, births or recruitment minus natural mortality."

This paper follows the convention set by Lange (2003). Her approach recognised the lack of information that is the norm in fisheries, it therefore collapsed recruitment, natural mortality and other volume changes, into the category: 'Other Volume Changes'. It should be noted, however, that annual stock assessments are carried out for the majority of commercial fish species and that a rigorous scientific approach is generally followed that estimates stock parameters and the fisheries managed by a suite of management options that include both input (effort) and output (TAC) controls.

5.2 Monetary Accounts

The monetary accounts mirror the physical accounts in structure, but specify the *value* of the stock and changes in the stock. Economic theory describes the value of a fish stock as the present value of the stream of rents it is expected to generate in the foreseeable future.

If an economic asset - quota to catch fish, in this case - is freely traded, the price

[9] South Africa lacks a regular survey of the fishing industry. The recommendation, contained in 2003's Economic and Sectoral Study of the South African Fishing Industry commissioned by the South African government in 2001 to establish a Fisheries Information System (FIS), is still in the process of development.

realised if that asset is sold should be that asset's value, or the discounted value of the stream of profits or rents it is expected to generate. In markets where Individual Transferable Quotas (ITQ) are used to manage a fishery the trading price of the quota should reflect a slightly conservative asset value of the targeted fish population. In reality, as the SEEAF handbook points out, "relatively few fisheries are managed through ITQs, and thus such quota markets do not exist. Even when ITQs are used, the market may be 'thin' or subject to other constraints that distort the quota price" (United Nations, 2004:28)

The management framework in South Africa technically precludes the trading of quota. That said, some trading does occur informally and anecdotal reports of the prices agreed on provide some scope for comparison with other methodologies of rent calculation. 'Paper quota' transactions have been a feature of the industry for the past decade and may offer some insights. Even where paper quota is not traded, rights are often bought and sold, giving an indication of the price – and hence the rent – of the resource. This comparison is made in Section 10.

Most commonly, the residual approach is used, whereby rent – which can be defined as the value of production minus the marginal exploitation costs – is calculated as the difference between revenue (or value of production) and costs. In actual implementation average cost is used rather than marginal cost because data about marginal costs are not generally available. This practice may introduce an upward bias into the measure of rent because average cost is usually lower than marginal cost. (United Nations, 2004: 41)

The residual approach depends on a comprehensive data source. Most rent calculations use information from existing national accounts but, unfortunately, South Africa's accounts lack detailed information on the fishing industry. Consequently the resource rent calculation in this paper is based on information from a fishing industry survey.

7. DATA SOURCE

The most comprehensive recent survey done was the Economic and Sectoral Study of the South African Fishing Industry in 2002 (ESS). The data in this survey is, however, 5 years old already thus, it was decided to use data from MCM's Long Term Rights Allocation Process (LTRAMP) from 2005.

As part of this process existing and potential new fishing entities were invited to apply for long-term fishing rights by fillling in one of 20 application forms for catching rights to species divided into 4 clusters. The clusters, and associated species, are listed in Table 2, below.

Table 2.

MCM's LONG TERM RIGHTS ALLOCATION PROCESS 2005: CLUSTERS

CLUSTER	SPECIES/FISHERY	INCLUDED IN STUDY
Cluster A	Hake Deep Sea Trawl	Yes
	Hake Inshore Trawl	Yes
	Horse Mackerel	Yes
	Small Pelagics	Yes
	Patagonian Toothfish	No
	South Coast Rock Lobster	Yes
	KwaZulu-Natal Prawn Trawl	No
Cluster B	Hake Long Line	Yes
	West Coast Rock Lobster (Off Shore)	Yes
	Squid	Yes
	Seaweed	No
	Tuna Pole	No
	Demersal Shark	No
Cluster C	Handline Hake	Yes
	West Coast Rock Lobster (Near Shore)	Yes
Cluster D	Beach Seine (Treknet) and Gillnet (Drift Net, Set Net)	No
	KZN Sardine Beach Seine	No
	Oysters	No
	White Mussels	No
Cluster Unknown	Traditional Linefish	No

Source: LTRAMP Database, 2005

Those species included in the study constitute the majority of the South African fisheries by value and by volume. Those not included generally did not have sufficient up-to-date data available to complete the rent calculation.

For reasons of confidentiality MCM provided raw data rolled up to the species/fishery level. While companies who had not been allocated rights were also invited to apply, the data was limited to that from applicants already in possession of quota or permit. Given honesty in the applications, the data should not, therefore, show any upward bias. In total, 1432 relevant applications were analysed. The resource rent is calculated for 2004, the year that the 2005 Rights Allocation Process treated as the test case, meaning that the full breadth of data was gathered only for this year.

While most of the data seems sound, there were clear problems with data fields requiring volume estimates – many of the results seemed unrealistically high. It is presumed that some companies provided volume in 'kilograms', as opposed to the 'tons' specified. As such, no volume data is utilised in the rent calculation. This data is in the process of being 'cleaned' and should in time become available to the staff at Stats SA who are commencing work on satellite accounts for the fishing industry.

Where volume data were required they were consequently taken from the annual stock assessment workshops and the ongoing outcomes of the modelling underlying the OMPs that drive current quotas[10]. The data used to construct the physical accounts are also taken from this source.

Prices are calculated from information on landings and turnover, arising from the quota allocation, for each fishery. Operating costs for each fishery have been divided into variable costs like Intermediate Consumption and Compensation of Employees, and fixed costs including consumption of Fixed Capital and a 'Normal Return' on Capital Stock.

This division could be seen as an oversimplification in the fishing industry where certain variables have a fixed, and a variable, component. 'Compensation of

[10] Run by the MARAM research unit, Dept of Applied Mathematics, UCT.

Employees', for example, is fixed in part by South Africa's minimum wage legislation. However, the actual earnings of workers on the boats are also tied to catch levels, similar to the piecework wages found in manufacturing elsewhere in the world, indicating a significant variable component to labour cost.

Another example is related to the consumption of fixed capital: while this is classified as a fixed cost, it includes a variable component related to the intensity of use of the asset, as well as the traditional fixed component related to the fact that the asset is a sunk cost that has a fixed depreciation path.

Recognising these problems, the resource rent is calculated using the following formula:

Equation 1

$$R^i = TR^i - (IC^i + CE^i + CFC^i + NP^i)$$

$$NP^i = \pi \times K^i$$

Where R = resource rent
TR = total revenue
IC = intermediate consumption
CE = compensation of employees
CFC = consumption of fixed capital (depreciation)
NP = normal profit
π = the rate of return on capital, considered the opportunity cost of capital
K = the value of fixed capital stock invested in the industry

For each fishery, i, where i = 1,2,3,4,5,6 for Hake, Small Pelagics, West Coast Rock Lobster, South Coast Rock Lobster, Squid and Horse Mackerel.

Source: SEEAF: 65

6.1 Intermediate Consumption

Intermediate Consumption is defined as the "value of the goods and services consumed as inputs by a process of production, excluding fixed assets whose consumption is recorded as consumption of fixed capital." (United Nations, 2004:

182). The data source used in this paper does not include a detailed breakdown of costs. As such, intermediate costs were estimated following on an economic model developed by the Namibian Ministry of Fisheries and Marine Resources, and adjusted for the South African market. In Namibia, Intermediate costs – mainly fuel – account for 38% of the value of output (Lange).

South African fishing firms have a similar cost structure except that levies and transport and processing costs are lower, while labour costs are higher. On average, intermediate costs are lower in South Africa. For example, on average the cost of fuel and ice made up approximately 23% of the landed value of Small Pelagics in 2005, down from 32% in 2000 (de Swart, 2006). Even including other intermediate costs, this falls short of the proportion in the Namibian fishery. It is estimated that intermediate costs in South Africa, dominated by fuel costs, are approximately 35% of output across the board (Japp: pers com 2006).

Intermediate consumption estimates from the national input/output tables were also investigated. These are described in detail in the macro-economic assessment and its appendix.

6.2 Fixed capital

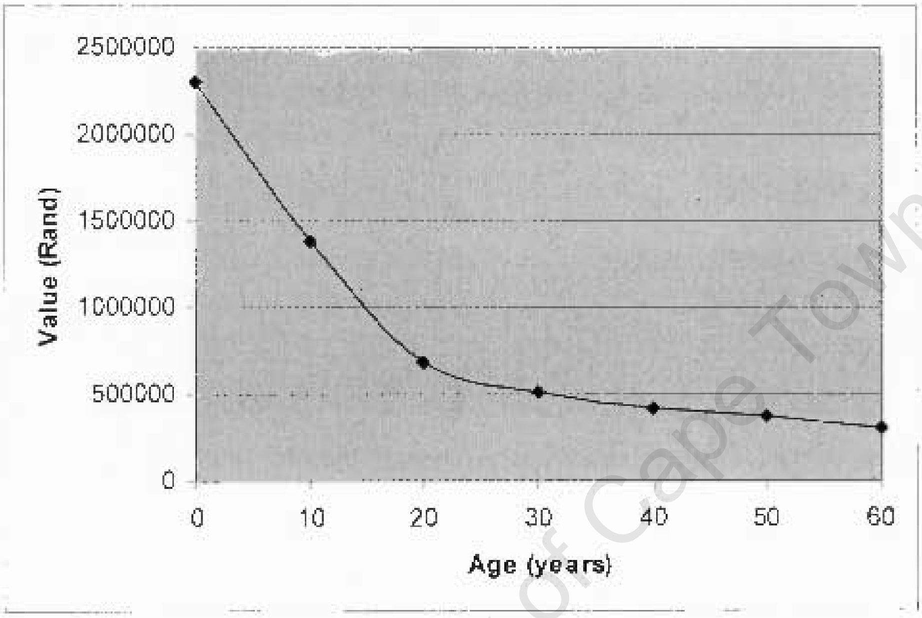
Fixed capital is identified as the book value of the fixed assets in the fishing industry. Those firms applying for long-term rights also disclosed their gross asset value and the insured value of their asset base. Because both measures would over-inflate the asset value, and the former wasn't broken down into land- and sea-based assets, the book value figures were used.

Anecdotal evidence and a few empirical studies[11], suggest that actual depreciation, at least with regard to the sea-based assets, could be hyperbolic – rather than traditional straight-line depreciation, these assets decline in value rapidly at first, and then at an ever-slowing rate. Effectively the value of a vessel declines as an asymptote and never becomes zero.

[11] See example below

Figure 4 shows the results of a study of the depreciation of vessels in the South African West Coast Lobster fishery. The depreciation rate approximates straight-line depreciation until around 20 years where after it extends, in a hyperbolic fashion, beyond sixty years.

Figure 4.



Source: Goss, 2006

While data constraints meant that straight-line depreciation had to be used in the derivation of the consumption of fixed capital in this rent calculation, it is clear that this is a very rough approximation of reality and that, in the future, efforts should be make to integrate a more realistic depreciation component into South Africa's fisheries rent evaluation model.

Table 3.

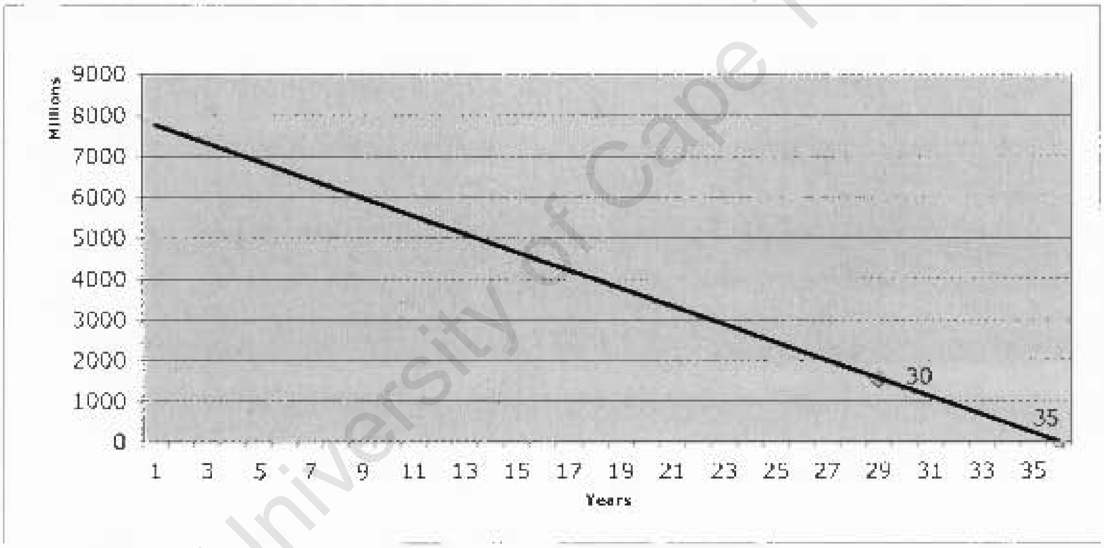
Fishery	**Average Age of Fleet**
Hake Average	29
Hake Deep Sea Trawl	*28*
Hake Inshore Trawl	*26*
Hake Longline	*33*
Small Pelagics	30
West Coast Rock Lobster	30

South Coast Rock Lobster	30
Squid	30
Horse Mackerel	31
AVERAGE	**30**

Source: BCLMEb, 2006

Figure 4 shows the depreciation of the total sea-based assets in the South African fisheries[12]. The average age of each of the fleets was calculated using the information in the BCLME Rightsholder Survey (BCLMEb, 2006) and the book value, or residual, was used to calculate the original asset value given a depreciation period of 35 years.[13]

Figure 4.



Source: Author's calculation from LTRAMP data, 2005

6.3 The rate of return on capital

The cost of fixed capital has two components. The first is the consumption of fixed capital, discussed above, while the second is a normal profit on fixed capital invested in the business– represented as π in the above equation.

[12] Those with sufficient information for inclusion in this study I.e.: the Hake, Small Pelagic, Lobster, Squid and Horse Mackerel fisheries

[13] Although sea-going assets are often depreciated over 20 years, anecdotal evidence from the industry and the age of the existing fleet (see Table 3) suggests that a depreciation period of 30 to 35 years would be more accurate.

The SEEAF Handbook identifies three main methods of calculating the opportunity cost of capital including: an estimation of the net operating surplus generated from the capital stock of the particular industry in question, the financing cost of the capital, or the opportunity cost of investment in the capital stock.

The first method usually requires the identification of a comparative industry with similar performance characteristics, and the second requires an assessment of measurable long term borrowing in the fishing industry. Because there is no obvious industry for comparison and no significant long-term borrowing in the industry, an opportunity cost needs to be identified.

Lange uses a 20 per cent rate of return in a study of the Namibian fisheries. This is justified "because of the very high risk due to unpredictable factors affecting the fish stock that business must be compensated for" (2003). This paper evaluates the resource rent given two different rates of return – 10% as the main rate, and 20% as a sensitivity analysis to assess rents if businesses are to be compensated for a higher risk factor in the fishing industry.

6.4 Vertical Integration

South Africa's fishing industry is characterised by extensive vertical integration between catch and processing with many firms extending their operation throughout the value chain. Because of this, and in line with the SEEAF's recommendation that, in the case of vertical integration "a true estimate of resource rent may only be obtainable if the boundary between the fishing and fish processing industries is relaxed and the residual method is applied to both activities," the primary industry and the processing industry were combined in this analysis.

A glance at the value chains in the industry will indicate that the average rents in the actual harvesting of fish are typically low. There are 'good years', but access to a permit is no guarantee of future wealth as the number of failed fishermen attests. Profit - as opposed to rent - is made further up the value chain. Appendix 2 reproduces the value chains for Small Pelagics and Horse Mackerel to show how far up the value chain the majority of profits are realised.

8. MEASURING ASSET VALUE

The value of a fish stock is the net present value of the rent it will generate in the future. In its full form this present value equation requires projections of:

- Future prices
- Technology
- Costs of Production
- Fish Stock Levels
- Resource Exploitation Paths (Lange, 2003:8)

Because information on the first three of these variables is not usually available, the convention has been to assume that they remain constant and to rely only on the last two variables.[14]

The SEEAF handbook details three possible long-run outcomes for future stock levels, which must assume constant effort/exploitation: the first is that stock levels remain constant, as does the associated resource rent; the second is that stocks rise over time, as does resource rent; the third is that stocks decline with time until they collapse and rent goes to zero.

The goal of fisheries management is to increase fish stocks, or maintain them at a sustainable level, so the third option is not a viable management outcome. Regarding the second option, the SEEAF notes that,

> *governments usually change management when a fish stock faces collapse in an attempt to restore the stock to previous high levels, but whether they succeed depends on three factors: (a) that the fish decline is, in fact, reversible; (b) that*

[14] It should be noted that costs of production, although assumed constant, in this model, vary considerably over time. These costs are strongly positively related to oil prices, which are notoriously volatile, they are also inversely related to stock abundance.

fisheries manager have sufficient knowledge of the fish dynamics to design effective measures to restore the fish stock; and (c) that there is a credible commitment by managers to policy changes, which may be politically very difficult. Most fisheries have not recovered as often, or as quickly, or to the levels that managers have set as objectives. (56)

Accordingly, it rejects the likelihood of option two, leaving what it calls "the most commonly used assumption – that fish stocks remain constant.

This means that the net present value equation takes a "reduced form" as shown in Equation 2.

Equation 2.

Assuming that fish are harvested at a constant, sustainable rate in perpetuity:

$VC^i = R^i / r$

Where	VC^i	is the value of the resource stock at the close of period t
	R^i	is the total rent at time t
	r	is the discount rate, 10% for these calculations

For each fishery, i, where I = 1,2,3,4,5,6 for Hake, Small Pelagics, West Coast Rock Lobster, South Coast Rock Lobster, Squid and Horse Mackerel.

Source: Lange (2006:8)

The discount rate used in Equation 2 is the *social discount rate* rather than the *private discount rate.* The former is generally lower than the latter for several reasons, outlined by the SEEAF Handbook, including: the existence of positive externalities which private savings decisions do not take into account, taxation and the difference in risk premia between small private enterprises which cannot really spread risk, and the State which can, and also runs a far lower risk of default.

Table 4 provides several examples of discount rates used to calculate fisheries asset value in other countries:

Table 4

Country	Discount rate
Iceland	8%
Namibia	10%
Norway	3.5%
United Kingdom	4%
United States	3%

Source: SEEAF: 58

For South Africa, a social discount rate of 10% (real) is usually used, to reflect a risk profile substantially different to that in developed countries.

The state guidelines for economic evaluations of projects in South Africa suggest that a sensitivity analysis be used. The traditional standard figure was 8% real but many recent papers replaced this with numbers as high as 10% or even 12% to show that marginal state projects were not competing with the private sector for scarce funds.

Although this case is somewhat different, fishing remains a typically high-risk business where hurdle rates are set far higher than in most land based operations. Industry interview indicate that the 10% used in this paper is therefore not high.

9. PHYSICAL ACCOUNTS

The physical accounts for the last eight to fifteen years appear below. The Small Pelagic fishery is the only one that has experienced increased biomass levels over the period. Most species appear to have shown significant variability in biomass levels between years, highlighting the difficulty in managing catch rates.

7.1 Hake

Table 5.

'000 Tons	Opening Biomass	Catch	Other Volume Changes	Closing Biomass
1990	425	137	135	423
1991	423	141	145	427
1992	427	142	149	434
1993	434	141	166	459
1994	459	147	184	496
1995	496	141	138	493
1996	493	159	150	483
1997	483	148	135	471
1998	471	154	122	438
1999	438	137	88	389
2000	389	155	142	376
2001	376	159	174	392
2002	392	147	149	393
2003	393	155	145	383
2004	383	154	136	365
2005	365	144	125	347

Source: MARAM research unit, Dept of Applied Mathematics, UCT

Hake biomass grew marginally in the early-nineties but began a gradual downward trend from 1995 to the present. The catch has remained relatively stable at around 147 000 tons.

7.2 Small Pelagics

Table 6.

'000 Tons	Opening Biomass	Catch	Other Volume Changes	Closing Biomass
1991	1097	202	1282	2177
1992	2177	401	282	2059
1993	2059	286	182	1954
1994	1954	249	91	1796

1995	1796	285	126	1636
1996	1636	146	137	1627
1997	1627	177	646	2096
1998	2096	236	755	2615
1999	2615	313	2210	4512
2000	4512	403	2758	6868
2001	6868	479	1590	7979
2002	7979	474	280	7785
2003	7785	549	-519	6717
2004	6717	564	-126	6027
2005	6027	529	-950	4547

Source: MARAM research unit, Dept of Applied Mathematics, UCT

Small Pelagic stocks have been extremely variable in the last fifteen years with the species experiencing almost 400 per cent growth from the chronically low levels of the nineties to 2002, when biomass peaked. Over this period the 'environmental' changes represented by "Other Volume Changes" have shown high volatility with the species recently experiencing decline in biomass levels that have even exceeded the total catch. This highlights the difficulties in managing the small pelagic fishery in South Africa.

7.3 WCRL

Table 7.

Tons	**Opening Biomass**	**Catch**	**Other Volume Changes**	**Closing Biomass**
1996	27035	2670	2651	27016
1997	27016	2758	1844	26102
1998	26102	2541	2412	25972
1999	25972	3175	5477	28275
2000	28275	2513	3558	29320
2001	29320	3041	3957	30235
2002	30235	3545	915	27606
2003	27606	3738	957	24825
2004	24825	4025	1459	22259

Source: MARAM research unit, Dept of Applied Mathematics, UCT

West Coast Rock Lobster biomass has been reasonably stable over the last eight years with a moderate decline in biomass levels and a significant recent increase in the catch. This species also shows a degree of variability with regard to environmental – or "Other Volume" - Changes

7.4 SCRL

Table 8.

Tons	Opening Biomass	Catch	Other Volume Changes	Closing Biomass
1996	3161	443	445	3164
1997	3164	416	469	3216
1998	3216	516	471	3171
1999	3171	512	431	3089
2000	3089	423	361	3027
2001	3027	288	296	3035
2002	3035	340	256	2951
2003	2951	350	234	2834
2004	2834	382	236	2688

Source: MARAM research unit, Dept of Applied Mathematics, UCT

There has been a modest decline in South Coast Rock Lobster biomass over the last eight years. Reported catch rates have also remained relatively stable over the period.

7.5 Squid

Table 9.

Tons	Opening Biomass	Catch	Other Volume Changes	Closing Biomass
1993	7923	6586	10092	11429
1994	11429	6928	5909	10410
1995	10410	7189	6564	9785
1996	9785	7261	5127	7651
1997	7651	4146	4293	7798
1998	7798	6801	8401	9398
1999	9398	7236	5942	8104

2000	8104	6686	4780	6198
2001	6198	3346	4606	7458
2002	7458	7273	9556	9741
2003	9741	9027	6952	7666
2004	7666	10396	9799	7069

Source: MARAM research unit, Dept of Applied Mathematics, UCT

The Squid fishery has experienced the most dramatic fluctuations in biomass and catch of all of the species analysed over the past ten years. Catch rates have changed by over 110 per cent in some years, and the biomass levels have also shown extremely variability with a downward trend over time.

7.6 Horse Mackerel

Table 10.

'000 Tons	Opening Biomass	Catch	Other Volume Changes	Closing Biomass
1990	728	52	19	694
1991	694	38	28	685
1992	685	36	39	688
1993	688	32	39	694
1994	694	18	32	708
1995	708	9	32	730
1996	730	28	31	733
1997	733	36	21	718
1998	718	55	17	680
1999	680	22	12	670
2000	670	23	27	673
2001	673	32	34	676
2002	676	24	35	687
2003	687	33	37	691
2004	691	43	41	689

Source: MARAM research unit, Dept of Applied Mathematics, UCT

While biomass levels have been comparatively stable over the past 14 years in the Horse Mackerel fishery, catch levels have been relatively variable with catch levels in 1995 dropping to 17 per cent of their 1990 levels before recovering almost fully by 2004.

10. MONETARY ACCOUNTS

Table 11 provides the summary results of the resource rent calculation for the South African fisheries for 2004. The detailed results are to be found in Appendix 1.

Table 11[15].

2004	Resource Rent (mil) - *10% OCC*	Resource Rent (mil) *- 20% OCC*	Rent per Ton - *10% OCC*	Asset Value (R mil)
Total Hake	551	446	3 571	5 514 (41%)
Deep Sea Trawl	*431*	*342*	*3242*	*4311*
Inshore Trawl	*63*	*58*	*6333*	*633*
Longline	*-14*	*-26*	*n/a*	*n/a*
Small Pelagics	310	249	549	3 097 (23%)
WCRL	297	281	73 676	2 965 (22%)
SCRL	36	33	95 046	363 (3%)
Squid	117	93	16 088	1 170 (9%)
Horse Mackerel	-31	-47	n/a	n/a
SA Fisheries	**1 357**	**1 134**	**1 840**	**13 572 (100%)**

Source: Based on author's calculations using methodology described in text

The Hake fishery generated the most rent in the South African fisheries in 2004, followed by the Small Pelagic, West Coast Rock Lobster and Squid fisheries respectively. The Horse Mackerel fishery generated a negative rent, reflecting the depressed state of this fishery and its associated market. The Hake Longline fishery also generated a negative rent, the most likely cause being the relatively high levels of capital stock in the fishery that increases the capital:output ratio and hence the opportunity cost of capital in the fishery as a whole.

[15] This table reflects the implications of differing opportunity costs of capital (OCC). A fishery typically involves a substantial investment in vessels and processing works. The opportunity cost of this investment (the amount it would yield at the market rate of interest) is the major component of normal profit and therefore has to be subtracted before rents can be assessed.

Both Rock Lobster fisheries generate extremely high rents per ton – several times the value generated by any of the other fisheries. This can be partially explained by the high international demand for Lobster products and the associated high prices offered. The Squid fishery also reports a high rent value per ton. Each of these rents per ton dwarfs those found in the relatively low value Small Pelagic fishery and the Horse Mackerel fishery who's prices appear so depressed so as to make the rent per ton negative.

Asset Value shows the contribution the resource makes to the fish wealth of South Africa. It is clear that Hake – specifically that component fished by the Deep Sea Trawl fishery - is the most valuable fish stock, followed by Small Pelagics and the West Coast Rock Lobster. Although South Coast Rock Lobster provides the most rent per ton of all of the species, the low volume caught lowers its overall contribution to South Africa's fisheries.

An anecdotal indication of the price of quota traded in the South African market suggests that West Coast Rock Lobster Quota fetches a price of around R35 per kilogram while trawl hake quota fetches a price of between R1.50 and R2.00 per kilogram[16] and hake longline, a price of between R8 and R20 per kilogram. At these prices, a "market-price" assessment of the resource rent of these fisheries indicate that the resource rent for West Coast Rock Lobster is around R140 million[17] while the resource rent for Deep Sea Trawl Hake is between R200 million and R266 million[18] and between R78 million and R196 million[19] for the Hake Longline Fishery.

While this method will typically understate the resource rent, the results for Deep Sea Trawl and WCRL are around 50 per cent of the rent calculated using the "residual

[16] Some hake operators are allegedly paying R3-50 per kilogram which is estimated to be economically impossible by most legitimate operators – the only way the buyer can benefit from the purchase of quota at that price is if they use it to catch "extra" or unreported fish (pers com: Japp, 2006).
[17] R3 500/ton multiplied by the WCRL catch of 4 025 tons
[18] R1 500 – R2 000/ton multiplied by the Hake Deep Sea Trawl catch of 133 000 tons.
[19] R8 000 – R20 000/ton multiplied by the Hake Longline catch of 9798 tons

value" method.[20] This result seems significantly lower than it should be, although this is more likely due to distortions in the market for quota reflecting, amongst other: a lack of competition, transaction costs and unequal power between buyer and seller. As such, the market-price method of rent evaluation appears to be relatively inaccurate in the South Africa fisheries.

11. RESOURCE RENT RECOVERED THROUGH TAXES

As the previous section shows, South Africa's fish resources generate substantial rent. Much, if not all of this rent, could theoretically be recovered by the State through levies and taxes.

This rent recovery could remove some of the incentive for over fishing and move the fishery to the most *environmentally efficient* equilibrium. The literature on the Namibian fishery (Lange, 2003) also shows how recovery of rent can promote *equity* by "recovering excess profits obtained from a national asset which can be used for development that benefits (for example) all Namibians not just the few involved in the fishing industry."

Theoretically, rent recovery by the State could also create incentives to encourage the most profitable, or *economically efficient* equilibrium. Many economists would, however, maintain that the private sector would be better equipped to invest these rents than the State would.

Table 12 details the degree to which resource rent is recovered, though taxation, by the South African government.

[20] The residual method of rent calculation presents a negative resource rent for the longline industry, while the "market-price" assessment indicates that the resource rent is significantly positive. This dichotomy could be explained by the extreme size of the capital stock, relative to the fishery's output, which – via an opportunity cost effect – lowers the rent estimate in the residual method's equation.

Table 12

	Resource Rent (mil) - *10% OCC*	**Levies Paid by Fishery (R mil)**	**Percent of rent recovered by levies**
Hake	551	29	5.3
Deep Sea Trawl	*431*	*25*	*5.9*
Inshore Trawl	*63*	*2*	*3.0*
Longline	*-14*	*2*	*n/a*
Small Pelagics	310	12	3.9
WCRL	297	7	2.3
SCRL	36	2	6.4
Squid	117	6	4.8
Horse Mackerel	-31	1	n/a
SA Fisheries	**1 357**	**57**	**4.2**

Source: LTRAMP, 2005

It is clear that a very small proportion – on average, less than 5% - of resource rent is recovered by the State. A recent study of the Namibian fisheries (Lange, 2003) found that the relatively low rate of rent recovery in that country was due to the "failure to index quota levies to inflation" (13).

Whether this is the case in South Africa is uncertain, although the State's rent recovery is a degree of magnitude lower than that in Namibia. Throughout the Nineties the cross-species rent recovery in Namibia ranged from 18 to 51 per cent (*loc cit)* whereas South Africa's is below 5 per cent for 2004.

12. MANAGEMENT IMPLICATIONS OF RENT DISSIPATION IN SOUTH AFRICAN FISHERIES

Fisheries managers in South Africa face a choice: they can cultivate a lean efficient profitable fisheries sector, which can be taxed to yield revenues that provide employment and meet development objectives elsewhere in the system. Alternatively they can coerce the industry into a higher cost, less efficient, but more labour-using system. Despite these efficiency losses, this approach may create jobs directly and can benefit those who have traditionally depended on the industry.

Put another way, by maximising rent, through the constraint of fishing effort, the fisheries managers will, theoretically, limit the number of direct jobs in the industry. They will, however, also maximise the potential rent available for extraction through levies and taxes.

Fisheries managers may, of course, choose to allow effort levels that may exceed the point where resource rent is maximised, presumably sacrificing tax income for direct job creation or wealth redistribution or to allow for stock recovery. It is essential that these managers have the information required to make such decisions. Currently this information is obtained largely by the scientists of MCM who are mostly funded by the State and indirectly by the fishing industry through taxes or levies.

Due to "open-access" nature of fisheries resources, managers will almost always have to constrain fishing effort to some degree to ensure the sustainability of the resource. That said, by relaxing the constraint on fishing effort by some degree they may be able to increase yields, to a degree, and presumably also increase employment. The cost here will be borne by the decreased rents realised by the industry and the lost opportunities in the extraction of levies and taxes.

Regional evidence, summarised by Lange (2003), suggests that the value of Namibia's fish assets increased by 37% between 1990 and 2000. This is attributed to "the partial recovery of some fisheries and improvements in management that have increased the rent generated." Limitations in reported year-on-year data mean that it is currently impossible to assess the South African fisheries in a similar fashion.

It is clear that South Africa needs to enhance its reporting of fisheries data in order to establish "comprehensive economics accounts" that integrate the value of natural resources into the existing national accounting framework through the establishment of satellite accounts.

Once such accounts are established[21] fisheries managers will be able to make more informed decisions regarding the allowable fishing effort and will have a view of the "total asset value" that will assist in the sustainable management of stocks.

By including an assessment of resource rent in the metrics used to manage South Africa's fisheries, the State could eventually identify a target potential rent that could be captured by the fisheries and - by managing effort to maximise this rent - could manage the stocks in order to raise catch-per-unit-effort, corporate profits, sustainable yields and tax takes. To the extent that research and management will be necessary to rehabilitate the resource, the burden of the associated costs can be justifiably shared.

[21] Changes stock levels will only be available ex-post, and then only once the available data has worked its way through the models iterative models that drive the OMPs. This means that once the satellite accounts are in place they will (as in normal in national accounts) face at least three or four years of adjustment before the rent estimates stabilise.

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APPENDIX 1

1. SA Fisheries

2004	SA Fisheries
Number of companies	*1,432*
Stock Estimate (t)	*7,213,221*
Recruitment & Mortality changes 2004 (t)	*896,610*
Catch - Butterworth (t)	*737,648*
Price (R/ton)	*7,942*
Jobs	*81,736*
Output (turnover generated by catch) (t)	*5,858,569,161*
Compensation of employees (R)	*1,998,776,953*
Capital Stock (R)	*2,235,121,423*
Intermediate Consumption	*2,050,499,206*
Consumption of Fixed Capital	*228,571,429*
Opportunity cost of capital	*10%*
RESOURCE RENT	***1,357,209,431***
Opportunity cost of capital	*20%*
RESOURCE RENT	***1,133,697,288***

2. Hake

2004	Total Hake
Number of companies	*260*
Stock Estimate (t)	*460,634*
Recruitment & Mortality changes 2004 (t)	*130,841*
Catch - Butterworth (t)	*154,403*
Price (R/ton)	*14,498*
Jobs	*34,477*
Output (turnover generated by catch) (t)	*2,238,581,421*
Compensation of employees (R)	*655,278,405*
Capital Stock (R)	*1,054,964,457*
Intermediate Consumption	*783,503,497*
Consumption of Fixed Capital	*142,857,143*
Opportunity cost of capital	*10%*
RESOURCE RENT	***551,445,931***
Opportunity cost of capital	*20%*
RESOURCE RENT	***445,949,485***

3. Hake – Breakdown

2004	Hake Deep Sea Trawl	Hake Inshore Trawl	Hake Longline
Number of companies	*53*	*17*	*141*
Catch - Butterworth (t)	*133,001*	*10,004*	*9,798*
Price (R/ton)	*1,210*	*18,240*	*398*

Jobs	19,017	4,558	10,902
Output (turnover generated by catch) (t)	1,812,482,906	188,947,757	174,609,536
Compensation of employees (R)	543,635,569	51,597,371	59,680,047
Capital Stock (R)	890,121,630	50,034,247	114,808,580
Intermediate Consumption	634,369,017	66,131,715	61,113,338
Consumption of Fixed Capital	114,285,714	2,857,143	57,142,857
Opportunity cost of capital	10%	10%	10%
RESOURCE RENT	**431,180,443**	**63,358,103**	**(14,807,563)**
Opportunity cost of capital	20%	20%	20%
RESOURCE RENT	**342,168,280**	**58,354,679**	**(26,288,421)**

4. Small Pelagics

2004	*Small Pelagics*
Number of companies	*109*
Stock Estimate (t)	*6,027,073*
Recruitment & Mortality changes 2004 (t)	*756,564*
Catch - Butterworth (t)	*563,910*
Price (R/ton)	*3,550*
Jobs	*11,148*
Output (turnover generated by catch) (t)	*2,001,720,328*
Compensation of employees (R)	*873,884,399*
Capital Stock (R)	*603,677,228*
Intermediate Consumption	*700,602,115*
Consumption of Fixed Capital	*57,142,857*
Opportunity cost of capital	*10%*
RESOURCE RENT	***309,723,234***
Opportunity cost of capital	*20%*
RESOURCE RENT	***249,355,511***

5. WCRL

2004	*Total WCRL*
Number of companies	*910*
Stock Estimate (t)	*24,825*
Recruitment & Mortality changes 2004 (t)	*1,459*
Catch - Butterworth (t)	*4,025*
Price (R/ton)	*209,473*
Jobs	*16,286*
Output (turnover generated by catch) (t)	*843,127,338*
Compensation of employees (R)	*219,255,962*
Capital Stock (R)	***150,863,912***
Intermediate Consumption	*295,094,568*

Consumption of Fixed Capital	*17,142,857*
Opportunity cost of capital	*10%*
RESOURCE RENT	***296,547,560***
Opportunity cost of capital	*20%*
RESOURCE RENT	***281,461,168***

6. **SCRL**

2004	***SCRL***
Number of companies	*17*
Stock Estimate (t)	*2,643*
Recruitment & Mortality changes 2004 (t)	*236*
Catch - Butterworth (t)	*382*
Price (R/ton)	*303,532*
Jobs	*2,160*
Output (turnover generated by catch) (t)	*115,949,255*
Compensation of employees (R)	*33,779,114*
Capital Stock (R)	***24,231,122***
Intermediate Consumption	*40,582,239*
Consumption of Fixed Capital	*2,857,143*
Opportunity cost of capital	*10%*
RESOURCE RENT	***36,307,647***
Opportunity cost of capital	*20%*
RESOURCE RENT	***33,884,535***

7. **Squid**

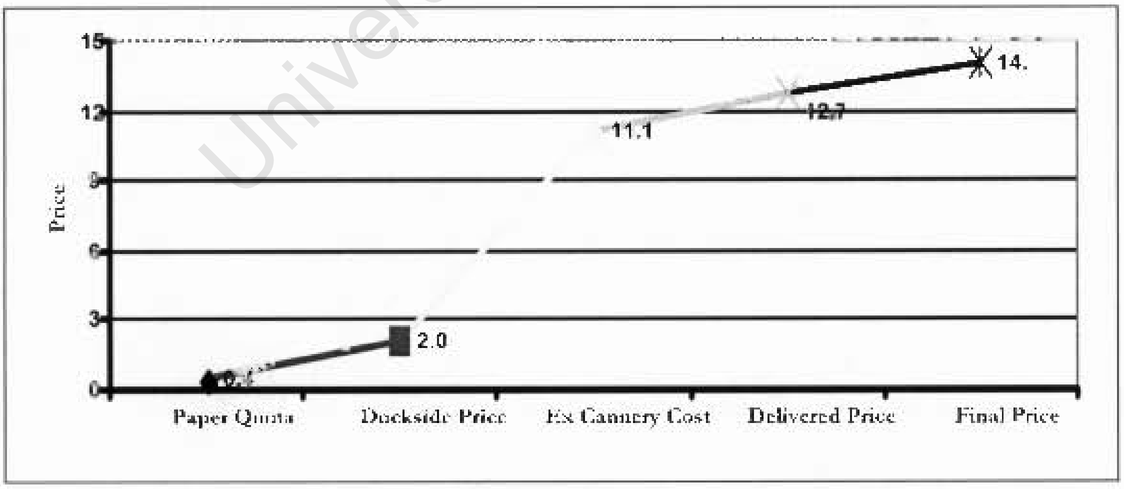
2004	***Squid***
Number of companies	*118*
Stock Estimate (t)	*7,458*
Recruitment & Mortality changes 2004 (t)	*4,606*
Catch - Butterworth (t)	*7,273*
Price (R/ton)	*79,368*
Jobs	*9,413*
Output (turnover generated by catch) (t)	*577,271,661*
Compensation of employees (R)	*176,890,215*
Capital Stock (R)	***241,757,977***
Intermediate Consumption	*202,045,082*
Consumption of Fixed Capital	*57,142,857*
Opportunity cost of capital	*10%*
RESOURCE RENT	***117,017,710***
Opportunity cost of capital	*20%*
RESOURCE RENT	***92,841,913***

8. Horse Mackerel

2004	***Horse Mackerel***
Number of companies	*18*
Stock Estimate (t)	*690,588*
Recruitment & Mortality changes 2004 (t)	*2,904*
Catch - Butterworth (t)	*7,655*
Price (R/ton)	*10,701*
Jobs	*8,251*
Output (turnover generated by catch) (t)	*81,919,157*
Compensation of employees (R)	*39,688,859*
Capital Stock (R)	*159,626,727*
Intermediate Consumption	*28,671,705*
Consumption of Fixed Capital	*28,571,429*
Opportunity cost of capital	*10%*
RESOURCE RENT	***(30,975,508)***
Opportunity cost of capital	*20%*
RESOURCE RENT	***(46,938,181)***

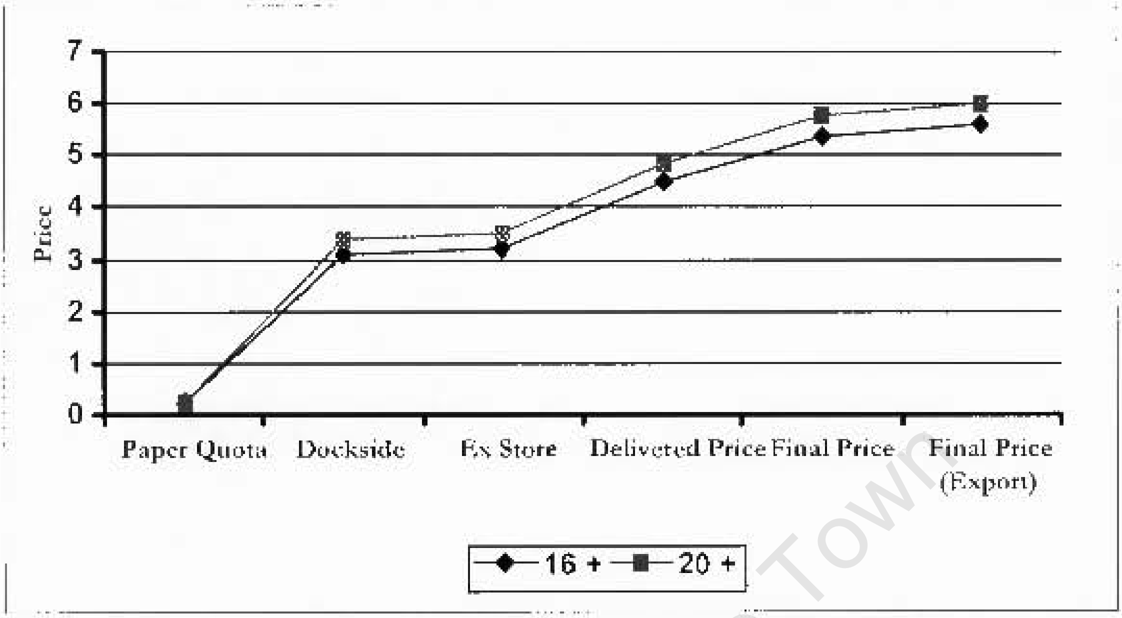
APPENDIX 2

Figure 5. The pilchard value chain represented graphically.



All prices are quoted in ZAR per kilogram. (Source: BCLME, 2006)

Figure 6. The horse mackerel (round) value chain represented graphically.



All prices are quoted in ZAR per kilogram. (Source: Industry Communication)